

Revit in Mechanical, Electrical, Plumbing (MEP) for Facility Management of College Hostel Building

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Abstract: - Higher education institutions buildings and facilities (Hostel Building) are considered a vital asset. Proper maintenance and timely rehabilitation is required to ensure: i) Building operation and maintenance costs are minimized and ii) Levels of service and quality standards are met. Inspection of building components is a necessary step to ensure that maintenance and rehabilitation needs are properly understood. This study proposes useful guidelines and processes to avoid making mistakes in the integration of the interface, which would necessitate redoing work, increase costs. Based on the importance of maintenance of such facilities, this Paper aims to investigate and document existing software systems used to manage operation, maintenance and inspection of hostel building. The objective of the MEP tool is to leverage the existing data in Revit to expedite and enhance the quality of building inspections. The MEP tool is based on the use of Autodesk Revit architect and linked with AutoCAD software. The MEP tool controls the inspection of building components where new inspection data are added such as assessment grade, repair priority, and type of component defect. Inspection results including costs and immediacy of repair can be reported on the software. A digital image database of building components at various stages of deterioration can be created to ensure a standardized condition rating during the inspection process.

Keywords: Assessment of Buildings, BIM, Component Defect, Inspection, Maintenance Management, Repair Priority, Software's – Revit and AutoCAD.

I. Introduction

Coordinating mechanical, electrical and plumbing (MEP) projects is a great challenge. The inability in identify conflicts in 2D-drawings create delays in the construction process and the increase of the administration burden due the identification of conflicts on field when the budget it's already approved; produces rework to correct problems unidentified in the project phase and influence the productivity of all the involved on the process. (Fig.no.1)

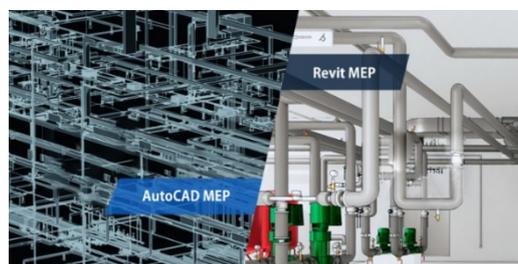


Fig.1. Simplification of MEP using Revit with 3D view

The use of Building Information Models (BIM) aims to simplify this task by creating a single unified Architecture. Building Information Modelling can help the Architecture, engineering and construction (AEC) industry to find possible problems before the beginning of the construction work, during the work and also after completion of work it is detected. They improve return on assets, decrease costs and risks, improve asset-related decision making and increase productivity. Revit software and its proposed integrated data base systems for the facilities components are representing a perfect platform for an assessment tool that controls the inspection activities necessary for the building maintenance.

The paper is focused in evaluating study associated with MEP system facilities of a Revit Model in association with BIM. Utilization of Revit software, will show how we can use Revit's software MEP system, families with more useful information, and manipulation of some parameters to automate various workflows in our MEP designs for facility management.

II. Objectives

The main objective of this study is to develop a software enabled building condition assessment tool to ensure consistent and cost-effective inspection of building components based on the use of Autodesk Revit architect software as the tool platform (Khanzode, A.; Fischer, M.; Reed, D.). The developed MEP tool will enhance the capabilities of the condition assessment of facilities. This system is developed to provide the user with the following objectives:

1. Collecting all the necessary information about building components, thus making it easy to decision-makers to have their quick action upon defects.
2. Saving both time and money for its quick response to maintenance staff.
3. Providing accurate maintenance information especially when attached with the different status images for assessment grades.
4. Saving inspection records by date enabled a good monitoring for the building element history which leads to definite repair decision.

III. Research Background

Chara Farquharson (MS), Jake A. Gunnoe (PhD) & Alfredo O. Rivera (PhD) carried out their research on detailed literature review examining how MEP is now used in the industry. Revit, a three-dimensional tool used to model a building and its components, is commonly used during the planning, design, construction and operation phases of a project. MEP System is an indispensable part of a building system; it requires proper and regular maintenance to ensure the safety and comfort of a building. BIM software, like Revit, has eased the designing, installation, and even maintenance of the MEP system. Revit MEP follows a preventive maintenance approach instead of a reactive approach by detecting and fixing the damage on-time. The data and information about the MEP system can be extracted from Revit to check the performance of key MEP elements. If any problem is detected, the elements can be replaced timely. They identified that While accommodating the MEP system, identifying the ceiling space is a problem. Using the virtual building model, Facility managers can get the space occupied by the MEP system and the available ceiling space. They can check their performance and compatibility and make the required changes.

The author concludes that Revit also aids the maintenance document by recording every minute detail while renovating. Maintenance of the facilities can be well planned and performed efficiently with Revit MEP. Any malfunction or issue in the fire alarm, plumbing unit, electrical or any other MEP component can be identified easily with Revit MEP. Surely, BIM has simplified the work of a facility manager to a great extent. Development of a digital image database of building components that are commonly assessed during a building inspection. The image database will show components at various stages of deterioration. Validation that each image corresponds to a particular condition through subject matter experts in each field (architectural components and electromechanical components)

Sanghyo Lee and Yonghan Ahn stated in their article of Analyzing the Long-Term maintenance life of MEP Using the Probabilistic Approach in Buildings that, establishing an effective long-term maintenance plan is essential to ensure the sustainability of a building. Among the various components of a building, the mechanical, electrical, and plumbing (MEP) components are complexly affected by various parameters, such as quality and user pattern, with respect to the service life. Besides, these components are replaced at different points in time, which becomes one of the main risks when establishing a maintenance plan for the building. The author states that the importance of building maintenance is emphasized around the world because of the growing complexity of buildings, the increasing proportion of systems in the buildings, higher levels of service, and the higher portion of maintenance costs in the life cycle costs of buildings. In this regard, Revit technology is studied in terms of not only enhancing the efficiency of MEP coordination in the design and construction phases, but also maintaining the MEP components (Fig.no.2)

Author explained the research with an example, Hu et al. (2018) proposed a set of solutions, including an approach for building the logic chain automatically, a mechanism of identifying and grouping equipment, and an algorithm for generating a Geographic Information System (GIS) map based on the building information during the delivery of MEP management in the operation and maintenance phase. Hu et al. (2016) developed a facility management system for MEP engineering based on multi-scale BIM (Revit) and examined its in-depth application to the MEP project of a large real-world airport terminal. In other words, Revit technology can improve the efficiency of maintenance work by providing the maintenance manager with as-built information of MEP components, such as topologic information(information of the components of the MEP system), logic relation, position information (locating the fixtures or parts in proper location),and design performance(their function and properties).Moreover, maintenance strategies are also needed for effectively using the maintenance-related information of MEP components, which is obtained in such a technical environment. Especially, since real users' pattern, deterioration, and other uncertainty factors exist in the maintenance.

The author concluded with the results showed that there were some time points when the centralized maintenance activity was needed in accordance with the specific service life times for heating/air conditioning, ventilation, power, and pipe components, which had relatively small uncertainties. Lighting, socket, communication, broadcast, and valve components needed periodical maintenance even when the service life time was set at the mean of the service life distribution. Since it was difficult to set up a performance deterioration time for detectors, cameras, and water pumps, continuous maintenance activities were required during the

entire lifecycle. However, detectors, cameras, and water pumps occupy a very small portion of the maintenance data used in this paper. Therefore, standard deviations of these components may appear relatively high owing to the insufficient number of units in the data. Thus, the repair frequency of these components will be low and relatively less maintenance activity will be needed. Therefore, maintenance managers should identify the importance of MEP components and establish effective long-term maintenance plans.

The above research background and many other information on the web inspired us to take over the topic for facility management of building specifically maintenance and inspection of Mechanical, Electrical and Plumbing using software i.e. Revit Architecture and MEP tool in the software.

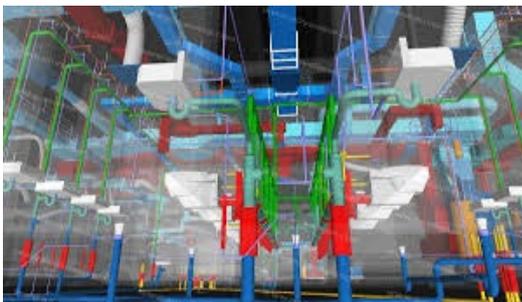


Fig.2. MEP components in 3D view in Revit software

IV. Project Work

The Assessment tools (MEP tools) covers a considerable parts of the inspection tasks

1. It allows inspectors to roughly estimate the cost for the urgent maintenance tasks of each building component individually.
2. The MEP tool saves time consumed in the assessment of defects since it standardizes the

assessment process and verifies the judgment through a standard deterioration images for each building component.

3. It provides the exact and precise location of the defect in the building and helps in ease of maintenance and inspection work.
4. It helps in inspecting the current condition of the property and provide a corresponding model regarding the defect in the property which require urgent maintenance.
5. It enhances the communication between managers and field inspectors.
6. The tools make the repair cost more determined since each inspection defect cost is preliminary estimated by the inspector.

Validation: - The selected building is five stories class hostel building with different entrance gate. The building contains most of the building components included in the developed assessment tool. The model was constructed in Revit architecture version 2018 starting from setting of the floors axes to the final top roof (Fig.no.4) For each story floor, walls, doors, windows and ceilings are added. The proposed assessment tool is developed based on the both Revit Architecture and AutoCAD software. The MEP tool is embedded in Revit and can link to AutoCAD where each building component has its individual table (Fig.no.5). The Revit database developed for each building model contains tables related to each building component; ceiling, door, duct fittings, ducts, flexure Ducts, floor, furniture, lighting Fixtures, pipe Fittings, piping, plumbing Fixtures, rooms, structural columns, walls and windows. The element is selected from the Revit building model by the mouse. Once the element is selected its predefined properties fields are displayed on the screen. The data entry can be done either from the properties tool box. Due to the use of Revit in Hostel Building planning the number of drawings are merged in one single software which improves the drawing to be more technically sound.

Example – For a section of core cutting in future, for the pipe fitting in ducts or outside the building a change has to be made in the AutoCAD drawings in every section i.e. Plans, Sections, Elevations but in case of Revit one change in a single section applies to each and every section which provides a technically sound plan of project.

1. Maintenance can be carried out in the Hostel building easily by having a perspective and 3D look in the system using the Revit Drawings (Fig.no.6), which will help in cost cutting and easy repair and maintenance work of the building.

2. It will also be easy to locate different joints and junctions which will help in locating during repairs or leakages. By showing the model it helps the maintenance team to know about the joints or bends from the model itself and they can easily go on the exact location instead of searching and wasting time on site.
3. It will also provide every single property of the material used in the building which will help in cost deduction and use the same range of materials after decoration of the older ones. If there is any kind of replacement we can know the quantity required as well, and so the maintenance team can take correct decision.

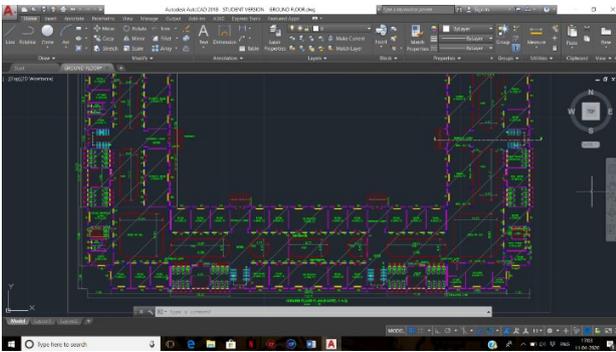


Fig.3. Ground floor plan of hostel building.

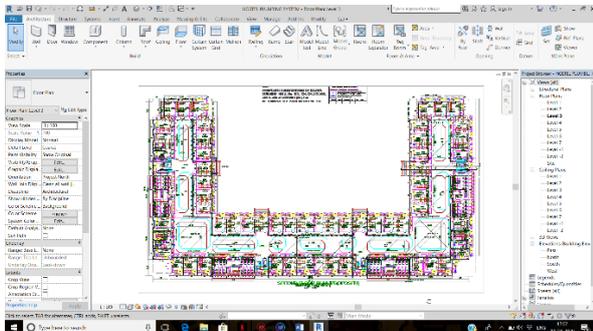


Fig.4. Hostel Building prepared in Revit Architecture 2018

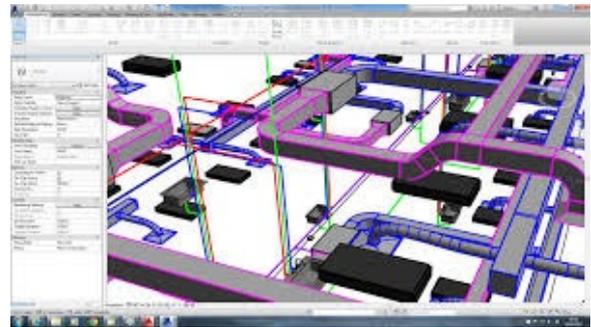
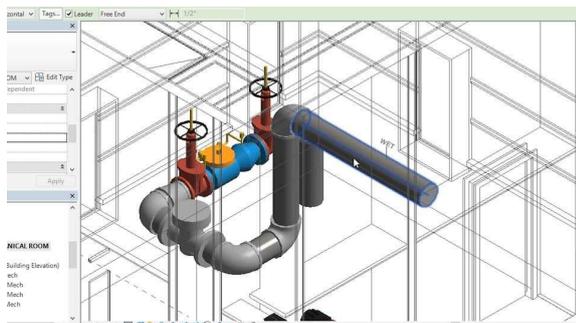


Fig.5. Component part of each Plumbing, Electrical, Mechanical.

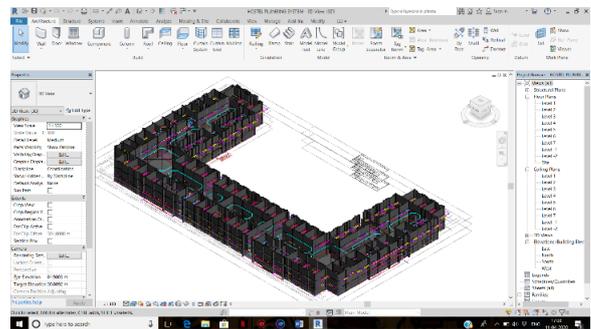


Fig.6. 3D view of hostel building

V. Methodology

This study is focuses at research for the easy and cost effective maintenance and inspection of the hostel building in order to avoid serious defects and problems occurring in the future and avoid deterioration of components or parts of the building of MEP system. Also, it aims at spreading the use of technology like Revit software to make it easy for the maintenance team and provide immediate position and the requirement of material in the process of maintenance. It also provides fast detection of leakages at precise point in the building which helps in easy locating of the defect and can consume less time and energy. It also avoids clash detection of MEP system (Fig.no.7) which helps the management team for maintenance work, about the advantages and also the long term cost savings through the use of technology and software.

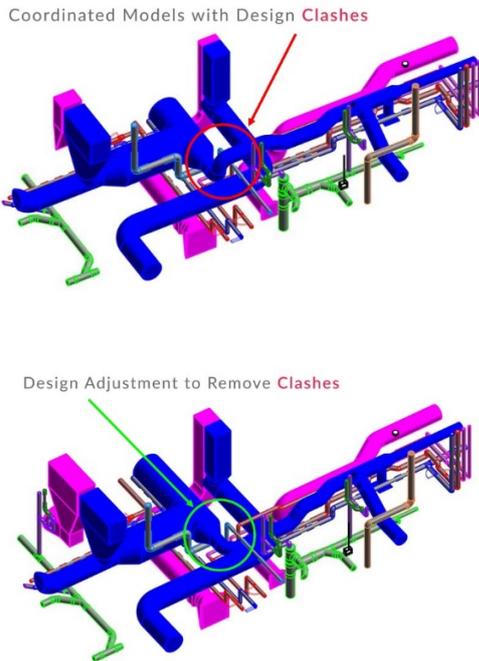


Fig.7. Remove Clash Detection using Revit Software

METHODOLOGY

- Case study and Selection of College Hostel building

Visit to the College hostel Building and preparing the Plan and section of building in AutoCAD and Revit software

- Placing all the Mechanical, Electrical and Plumbing lines in the Plan of Revit to avoid Clash detection

Installing all the parts, components or fixtures of Mechanical, Electrical and Plumbing in the Revit MEP tool with their functions and properties like resistivity, weight, fire resistance, height, width etc.

- Maintenance and Inspection work with Checklist

Correction of defects using Revit 3D model to identify location and connection of points, joints in the property or building

- Reporting the Defect in the MEP tool - Type of defect, defected material, position of defect, required material, date of inspection and completion of maintenance.

Preparing the report of the defect identified and its maintenance work.

Fig.8. Flowchart of Methodology

VI. Conclusion

This paper aimed to develop a Revit-enabled integrated tool for the inspection and condition assessment of building components that can overcome the drawbacks of the manual traditional practices of such processes.

The MEP tools used the common Revit architecture as a platform to manage the inspection process for different building components. The tool adds-in menu contain all corresponding options that enables the inspector to enter data and make the proper judgment. It also helps in locating the defect easily due to 3D modelling of the plan and prepare a report in the boxes given in the MEP tool, as when it was defected, what was defected and material required.

The presence of preliminary estimated cost for the defect repair makes it easier to assign more definite budgets. The tool reports help for proper repair decision making and improve the process with ease.

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